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(54) Method for displaying images on a display device, as well as a display device used therefor

(57) Method for displaying images on a display device, whereby the data (11) for forming the successive images are transformed in signals for a display (3), characterized in that the image display is improved by evaluating the above-mentioned data and by applying a dynamic image stabilisation on the basis of this evaluation, whereby one or several of the following techniques are used for the dynamic image stabilisation:

- a time-dependant image stabilisation;
- a frequency-dependant image stabilisation;
- an amplitude-dependant image stabilisation;
- an image stabilisation as a function of the entire image content.

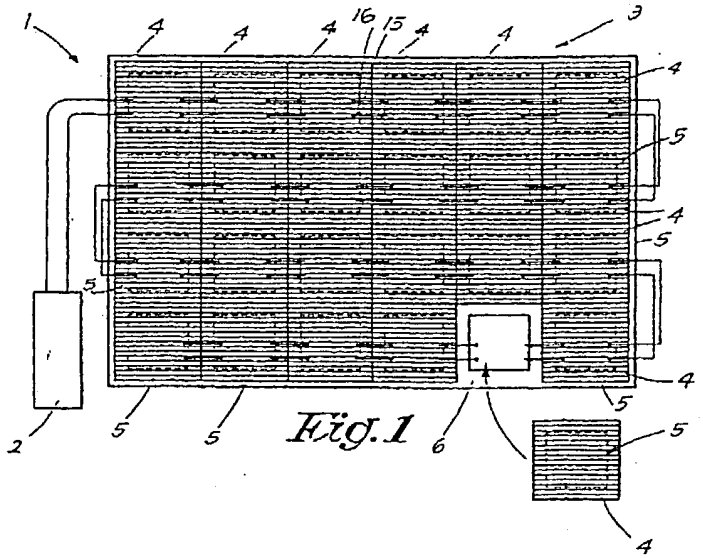

Fig. 1

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Description

[0001] The present invention concerns a method for displaying images on a display device, as well as a display device for realising this method.

[0002] In particular, the invention concerns display devices comprising a display which consists of several display units, whereby these display units are driven by means of a general processing unit, as well as by means of individual processing units per display unit.

[0003] In particular, it concerns display devices which make it possible to display images on a large image surface.

[0004] The invention is particularly meant for display devices comprising display units whereby the image is reproduced by means of what are called LED's (Light Emitting Diodes).

[0005] It is known that a LED wall can so to say be built in this manner. It is also known that, by building the LED wall from groups of LED's of different colours, in particular red, blue and green, by appropriately adjusting the intensity of the different LED's, it is possible to obtain various global colour effects. Also, by means of an appropriate control of the LED's, it is possible to reproduce moving images in colour, for example video images, on the LED wall.

[0006] Such display devices can be used for different purposes, for example for displaying images in stadiums, information and/or publicity in public buildings, such as for example airports, stations, etc. Display devices using LEDs are known from US 5.523.769, US 5.396.257 and FR 2.640.761.

[0007] The invention aims a method for representing images on a display device, whereby this method allows to improve the quality of the image.

[0008] In the first place, the method of the invention is designed for LED screens, but it can also be applied in a more general way in other display devices, such as CRT/LCD/DLP projectors and the like.

[0009] To this aim, the invention concerns a method for displaying images on a display device, whereby the data for forming the successive images are transformed in signals for a display, characterized in that the image display is improved by evaluating the above-mentioned data and by applying a dynamic image stabilisation on the basis of this evaluation, whereby one or several of the following techniques are used for the dynamic image stabilisation:

- a time-dependant image stabilisation, whereby it is verified for pixels of the image how alterations in time occur between successive images, and whereby an image stabilisation effect is provided for before the images are displayed;
- a frequency-dependant image stabilisation, whereby it is verified how alterations occur in pixels of the image situated next to one another, and whereby an image stabilisation effect is provided for before the images are displayed;
- an amplitude-dependant image stabilisation;
- an image stabilisation as a function of the entire image content.

[0010] According to a preferred embodiment use is made of a display device comprising at least a general processing unit, a display consisting of several display units and an individual processing unit per display unit, whereby, in order to display the images, data concerning the image to be displayed are transmitted from the general processing unit to the individual processing units in the form of a data stream, in that there is a control communication between the general processing unit and each of the individual processing units in the form of control signals, and in that data from the data stream are collected at every individual processing unit as a function of the control signals transmitted to the individual processing units.

[0011] As the data stream is offered to each of the individual processing units on the one hand, and there is a control communication on the basis of which the individual processing units are driven on the other hand, one obtains that every display unit can work independently of the other ones, requiring no communication with a central individual processing unit. As no mutual data exchange is required between the individual processing units, there will be less data transmission, making more calculation time and calculation capacity available for processing the signals in the individual processing units.

[0012] Use is preferably made of display units which are serially coupled. As a result of this, the total display can be easily composed in any size whatsoever, without a large number of electric connections being required on the back side of the display.

[0013] As already mentioned, use is preferably made here of display units consisting of LED panels.

[0014] According to the most preferred embodiment, a distributed signal processing will be provided for according to the invention between the general processing unit on the one hand and the individual processing units on the other hand. This implies that a number of calculations are made in the general processing unit, whereas a number of other calculations are made in each of the individual processing units. This requires less data exchange between the general processing unit and the individual processing units for the drive, making calculation time available in the general processing unit, as well as transmission time for data via the data line between the general processing unit and the individual processing units which can then be used for a refined transmission of data for displaying the image.

[0015] The invention also concerns a display device for realising the above-mentioned method, characterised in that it consists at least of a general processing unit; a display consisting of several display units; an individual processing unit per display unit; means which transmit at least data concerning the image to be dis-

played transmitted from the general processing unit to the individual processing units in the form of a data stream; means providing for a control communication between the general processing unit and each of the individual processing units in the form of control signals; and, per individual processing unit, means which collect data from the data stream as a function of the transmitted control signals for further processing and display.

[0016] In order to better explain the characteristics of the invention, the following preferred embodiment according to the invention is described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

figure 1 schematically represents a display device according to the invention;
figure 2 represents a model of the display device in figure 1 in perspective;
figure 3 represents the part which is indicated by F3 in figure 2 to a larger scale;
figure 4 represents the back side of the module from figure 2 in perspective;
figure 5 represents the display device in the form of a block diagram;
figure 6 represents a number of histograms with reference to images to be displayed;
figure 7 schematically represents a special image geometry.

[0017] As represented in figure 1, the display device 1 according to the invention mainly consists of a general processing unit 2 and a display 3 consisting of a screen which is composed of several display units 4, whereby every display unit 4 is equipped with an individual processing unit 5.

[0018] The general processing unit 2, also called digitizer or video engine, consists of an appliance which transforms image signals, either coming from an external source or from an internal source, such as a built-in video player, into digitised signals which are suitable for the reproduction of the image on the display 3.

[0019] As represented in figures 2 to 4, the display units 4 consist of tile-shaped modules which, as represented in figure 1, can be assembled by attaching them on an appropriate supporting structure, for example a frame 6.

[0020] The modules are preferably fastened in the frame 6 in a detachable manner, for example by making use of fastening elements 7, as represented in figure 4, with which the modules can be snapped in the frame 6.

[0021] The image side 8 as shown in figure 2 and 3 of the display units 4 is equipped with luminous elements, in particular LED's (Light Emitting Diodes), which are indicated hereafter in a general manner with the reference 9, but which are indicated with the references 9A to 9E when represented in detail.

[0022] Refering to figure 3, the LED's 9A and 9E are red for example, whereas the LED's 9B and 9D are green and the LED's 9C are blue. By controlling the respective LED's 9A-9E and by thus making the different colours illuminate with different intensities, it is possible to realise any colour whatsoever when seen from a distance. Every set of LED's 9 hereby forms a pixel of the images to be formed. It should be noted that such a pixel can be composed in different ways, of three colours or of a combination of different groups of LED's 9. Thus, for example, the LED's 9A-9B-9C form a group of basic colours with which all colours can be formed. The same goes for the LED's 9B-9C-9E as well as for 9D-9C-9E and 9A-9C-9D.

[0023] In the preferred embodiment of figure 5 the display device 1 is equipped with means 10 which at least transmit data concerning the image to be displayed transmitted from the general processing unit 2 to the individual processing units 5 in the form of a data stream 11; means 12 providing for a control communication between the general processing unit 2 and each of the individual processing units 5 in the form of control signals 13; and, per individual processing unit 5, means 14 which collect data from the data stream 11 as a function of the transmitted control signals 13 for further processing and display on the image surface, in this case the LED panel, of the display unit 4 concerned.

[0024] It should be noted that the data stream 11 and the control signals 13 are only represented schematically in the diagram of figure 5 and that, in reality, the data stream 11 and the control signals 13 are not necessarily carried via two different data lines. The data stream 11 and the control signals 13 may consist of a single pulse train in which certain intervals are reserved for the data stream 11 and other intervals are reserved for the control signals 13.

[0025] For practical reasons, however, it may be necessary to make different connections between the individual processing units 5, for example in the case where a separate data processing is provided for the different colours, for the control of the red, green and blue LED's 9 respectively, whereby it is transmitted separately per colour to the processing units 5.

[0026] Thanks to the design according to figure 5, however, it is possible to use a restricted number of electric connections between the successive display units 4, and they can be coupled serially by means of a number of electric cables 15-16 as shown in figure 4, in particular twisted pairs, which are provided with multipolar connectors 17 which can be plugged in the back side of the processing units 5.

[0027] According to a special aspect of the invention, a distributed signal processing is provided for between the general processing unit 2 on the one hand and the individual processing units 5 on the other hand. This implies that a number of data are processed and calculated in the general processing unit 2, whereas a number of other data are processed and calculated in each of the individual processing units 5.

[0028] This distributed signal processing can be car-

ried out at different levels.

[0029] According to a first aspect, a distributed signal processing of the signals related to the colour rendering is provided for, in other words a distributed colour processing. Also a distributed signal processing related to the brightness and/or contrast can hereby be provided for.

[0030] In particular, one or several adjustments are made at the general processing unit 2 related to one or several of the following possibilities:

- image stabilisation and/or noise suppression;
- tracking of the illumination of the image, in other words 'luminance tracking', whereby certain values of the luminance are included;
- histogram equalisation as a function of the entire image to be displayed;
- observing of what is called cue flash and acting appropriately in case of such a cue flash;
- scaling of the image in relation to the original input image in the horizontal and/or vertical direction.

[0031] This implies that the noise suppression is done in a general manner for the entire image display.

[0032] Luminance tracking implies determining for example a fixed relation between the different colours beneath a certain luminance before the signals concerned are transmitted to the individual processing units 5.

[0033] By histogram equalisation is meant that a histogram of the entire image content is made and that an evaluation is subsequently made and, if necessary, corrections will be made as a function thereof before the data stream 11 is transmitted to the processing units 5.

[0034] By way of illustration, figure 6 represents different curves which can be found in a histogram. H hereby represents the luminance value and I the number of times such values occur in this image. The curves represent all the pixels of the image.

[0035] In the case of an image which is generally rather grey, a curve A is obtained, a bright image produces the curve B and a dark image the curve C.

[0036] As a function of the nature of the curve, either curve A, B or C, a correction can thus be made. One possibility is that, when signals are observed indicating that the image is dark (curve C), the data stream 11 is adjusted such that the darkness is stressed, whereas when signals are observed indicating that the image is bright (curve B), the data stream 11 is adjusted such that the brightness is stressed. In case of curve A, for example, no correction is made.

[0037] The adjustments resulting from the evaluation of the histogram can also be linked to time. This implies that also alterations in the histogram for each of the successive images are detected and taken into account. In case of slow alterations, alterations in the output signal will be made less quickly, as a result of which is obtained a stabilisation effect.

[0038] What is called a cue flash is a sudden alteration of the entire image content, in other words a sudden change in the displayed image. It is clear that, at such a moment, the alteration should not be ignored. A detection of the cue flash allows for appropriate action at that moment.

[0039] In order to obtain a distributed signal processing, one or several individual adjustments are made at the individual processing units 5 as well. In particular, these adjustments concern one or several of the following possibilities:

- adjustment of the colour co-ordinates;
- adjustment of the brightness;
- adjustment of the contrast;
- corrective adjustment as a function of the temperature and/or age of the display unit 4;
- adjustment of the transfer functions RGB (red, yellow, blue);
- enlargement of the incoming video signal in the horizontal and/or vertical direction.

[0040] A number of these items will be illustrated in greater detail hereafter.

[0041] By colour co-ordinates are meant the co-ordinates in the chromaticity diagram. These co-ordinates determine what colour is visually observed, and they depend on several factors. Thus, for example they are linked to the age of the display unit 4, such that the adjustment must be made individually. However, the adjustment contributes to the general smoothness and uniformity of the colour reproduction in the image.

[0042] In order to adjust and improve the contrast, different modes are applied in the individual processing units 5, whereby the linear relation between the input signal and the output signal is adjusted towards a non-linear relation, whereby for example dark signals are further reduced in order to make sure that the LED's 9 remain switched off in case of signals indicating that there is a very dark image part, whereas for example signals indicating that there is a bright image, are reinforced.

[0043] Thus can be obtained among others that when the viewer is situated close to the display 3, the dark passages will indeed be perceived as being dark, and any annoying flashing of the LED's 9 which can be perceived from nearby is excluded.

[0044] In particular, a dynamic sample weight distribution is applied above, whereby the individual processing units 5 are informed via the control signals 13 of what curve should be followed during the transformation of the linear course into the non-linear course, depending on the aimed effect.

[0045] This technique allows for a refined contrast rendering without requiring a large number of contrast level differences in the signal of the general processing unit 2 towards the individual processing units 5. By using different curves, it is possible to create different results, and transmitting a restricted signal from the general processing unit 2 to the individual processing units 5 will

suffice to indicate to the latter what curve should be followed.

[0046] By providing for a corrective adjustment as a function of temperature and/or age per display unit 4, and thus also per individual processing unit 5, also other influences of temperature and/or age known as such are separately dealt with, and on condition that there is an appropriate control, differences between the displayed image in each of the display units 4 are excluded. Thus, it is possible to remove display units 4 from the display 3 and to replace them at any time, without any disadvantages. It is also possible to build a display 3 of any size whatsoever, even when it contains display units 4 which have been in use for a shorter time than a number of the other display units 4. By age should in this case mainly be understood the total time during which a display unit 4 has been switched on.

[0047] The temperature correction offers the advantage that mutual deviations resulting from temperature differences, irrespective of the cause of these temperature differences, are excluded. Said temperature differences may occur for example when, for a longer length of time, only a part of the display 3 is driven so as to form an image, whereas from a certain moment on, the entire display 3 is used. Consequently, the display units 4 which have not been in use until then will not function at operating temperature, and an adjustment because of the temperature differences is advisable.

[0048] According to another aspect of the invention, also a distributed signal processing of the signals related to the image display, in other words a distributed image processing, is provided for.

[0049] An example of such distributed image processing consists in that a distributed signal processing is provided for which makes sure that, both at the general processing unit 2 and at the individual processing units 5, measures are taken to minimise image flickering.

[0050] In a preferred embodiment, the line frequency is raised to this end in the general processing unit 2 in order to eliminate what is called the interline flicker. It will be raised for example from 15 kHz to 32 kHz.

[0051] However, in the individual processing units 5, one or several individual adjustments are made which make sure that every display unit 4 operates frequency-independent vertically and horizontally. This adjustment consists for example in realising an automatic pulse width adjustment and/or in carrying out a frequency raise to eliminate what is called surface flicker.

[0052] The pulse width adjustment offers the advantage that one can for example automatically switch from a 50 Hz system to a 60 Hz system without any discontinuities being perceived in the displayed image. The automatic pulse width adjustment is preferably carried out by creating free spaces in between the pulses, whose interval is adjusted such that the entire signal becomes totally continuous.

[0053] The frequency is raised from for example 50/60 Hz to at least 100 Hz and better still to 400 Hz.

[0054] According to yet another aspect of the invention, a distributed signal processing of the signals determining the image geometry is provided for.

[0055] In order to obtain a certain image geometry, control signals 13 are hereby transmitted to the individual processing units 5 which indicate which part of the image should be displayed at the display unit 4 concerned, whereby the individual processing units 5 then collect data from the data stream 11, process them and display them, as a function of said control signals 13.

[0056] An example thereof of represented in figure 7, whereby the entire image which is normally displayed in the rectangle defined by the entire surface of the display 3, is compressed into a triangle 18. The image B1 of the picture line 19 must hereby no longer be displayed over the distance X, but over the short distance Y. In this case, the display units 4A and 4B will not be ordered to collect data from the data stream 11 via the communication protocol which is contained in the control signals 13, whereas the display unit 4C will be ordered to collect all the image information of the image B1 from the data stream 11, and to display this image B1, of the picture line 19, over the distance Y. The general processing unit 2 hereby only gives a command, whereas the recalculation for the display of the image B1 over the distance Y is carried out in the processing unit 5 of the display unit 4C.

[0057] According to the presently claimed invention, a dynamic image stabilisation is provided for.

[0058] To this end, one or several of the following techniques are preferably used:

- a time-dependant image stabilisation, whereby it is verified for pixels of the image how alterations in time occur between successive images, and whereby an image stabilisation effect is provided for before the images are displayed, for example by ignoring or attenuating brief alterations;
- a frequency-dependant image stabilisation, whereby it is verified how alterations occur in pixels of the image situated next to one another, and whereby an image stabilisation effect is provided for before the images are displayed;
- an amplitude-dependant image stabilisation;
- an image stabilisation as a function of the entire image content.

[0059] Such an image stabilisation can be realised either exclusively at the general processing unit 2 or exclusively at the individual processing units 5, but also distributed over both.

[0060] It should be noted that the improvement of the image display by means of such a dynamic image stabilisation can also be applied in other display units 1 than those described above, namely also in display units which are not assembled from different display units 4 and which do not necessarily have to be of the LED type. Hence, as far as the dynamic image stabilisation is con-

cerned, the invention is not restricted to the above-described display device 1, and it also extends to othere display devices, including CRT projectors, picture tubes, etc.

[0061] According to a special characteristic of the invention, both the signals of the data stream 11 and the control signals 13 are successively displayed from one display unit 4 to the next, and a number of, preferably each of the individual processing units 5 is provided with a master clock correction. This implies that all the signals, at each transition to a subsequent display unit 4, are again optimally adjusted to one another, so that possible transmission errors are excluded, if not minimised.

[0062] In practice, different signals are preferably used for the basic colours red/green/blue (RGB signals), and possible transmission errors in these RGB signals are minimised thanks to the above-mentioned master clock correction, in particular a cumulation of shifts and errors resulting from what is called jitter is counteracted at the master clock.

[0063] Such a master clock correction is preferably carried out by means of a proprietary crystal clock in each of the individual processing units 5.

[0064] Practically, the LED's 9 are driven by means of an uninterrupted current during normal operation, whereby the length of time for which the current is switched on is used as a control parameter. Moreover, in order to adjust the brightness and contrast, the value of the above-mentioned current can be altered.

[0065] It is clear that the general processing unit 2 and the individual processing units 5 are equipped with the necessary electronic circuits in order to process the data as described above, in other words to realise the above-mentioned means 10, 12 and 14. Any craftsman can derive from the above-described operations how these circuits should be built.

[0066] It should be noted that the display device 1 preferably also contains means to automatically recognise the position of a display unit 4 in the total image surface. These means consist for example in that, when the processing unit 2 is switched on, it assigns the address '1' to the first display unit 4 coupled in series, the address '2' to the second one, and so on. In case of a systematic 'through' coupling as represented in figure 1, and when the number of display units 4 are put in per row, as well as the number of rows of display units 4 among themselves, the processing unit 2 will automatically determine the position of each display unit 4 in the total display 3.

[0067] The invention is by no means limited to the above-described embodiment represented in the accompanying drawings; on the contrary, such a method for displaying images on a display device, as well as the device used to this end, can be made in all sorts of variants while still remaining within the scope of the invention.

Claims

1. Method for displaying images on a display device, whereby the data (11) for forming the successive images are transformed in signals for a display (3), **characterized in that** the image display is improved by evaluating the above-mentioned data and by applying a dynamic image stabilisation on the basis of this evaluation, whereby one or several of the following techniques are used for the dynamic image stabilisation:

   - a time-dependant image stabilisation, whereby it is verified for pixels of the image how alterations in time occur between successive images, and whereby an image stabilisation effect is provided for before the images are displayed;
   - a frequency-dependant image stabilisation, whereby it is verified how alterations occur in pixels of the image situated next to one another, and whereby an image stabilisation effect is provided for before the images are displayed;
   - an amplitude-dependant image stabilisation;
   - an image stabilisation as a function of the entire image content.

2. Method according to claim 1, **characterized in that** it is applied with a display device comprising LEDs.

3. Method according to claim 1 or 2, **characterized in that** a display device is applied which is composed of several display units (4).

4. Method according to claim 3, **characterized in that** individual processing units (5) are used for the adjustment of the respective display units (4), whereby said image stabilisation takes place by means of distributed signal processing.

5. Method according to claim 4, whereby in accordance with this method at least an adjustment of the colour co-ordinates is carried out.

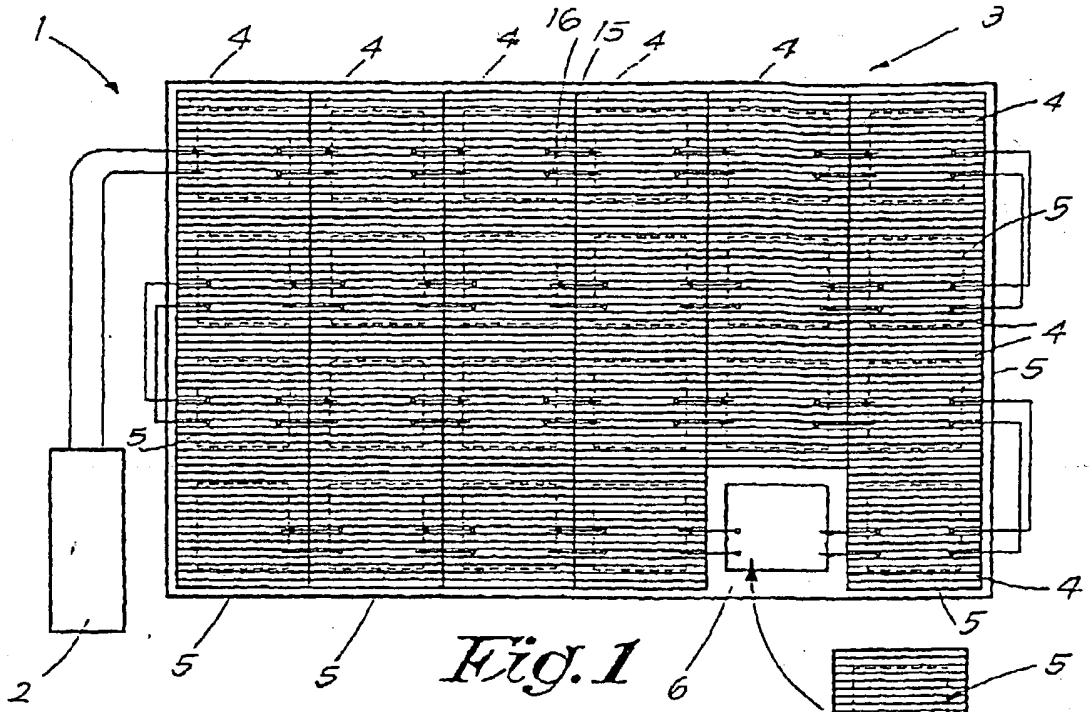

Fig.1

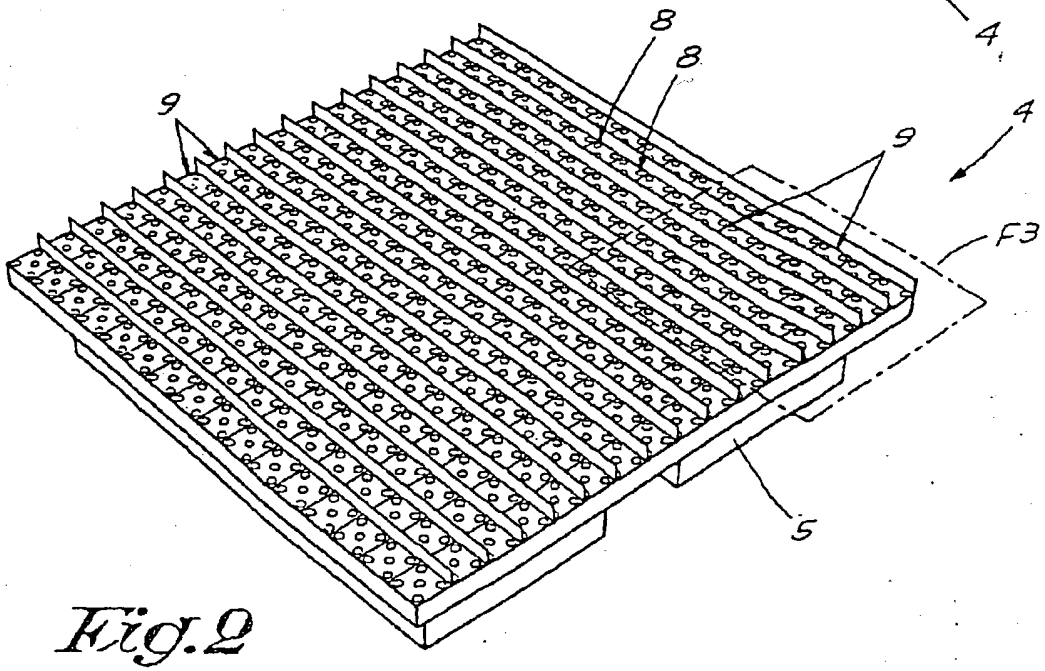

Fig.2

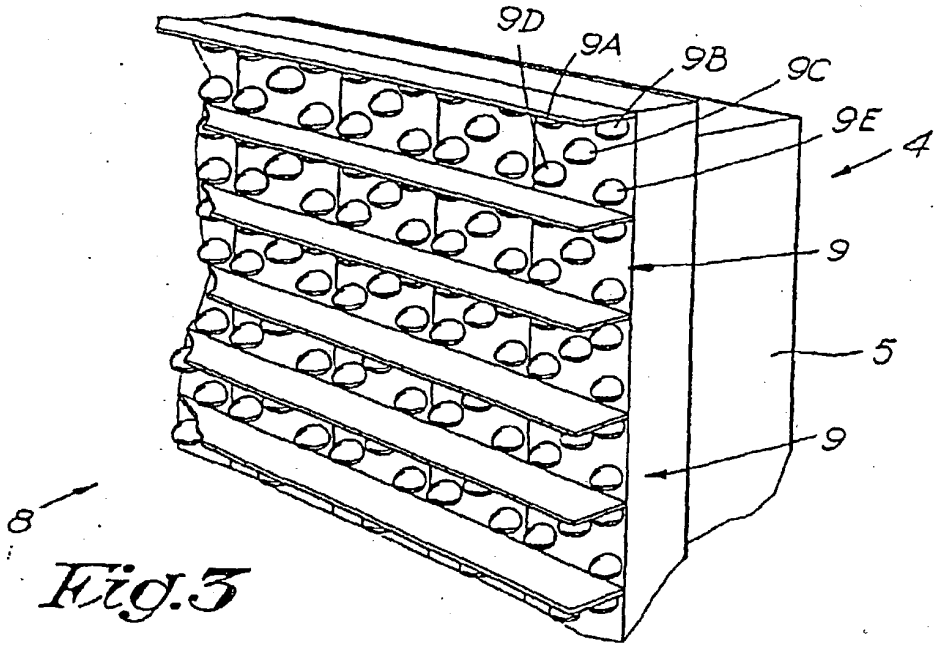

Fig.3

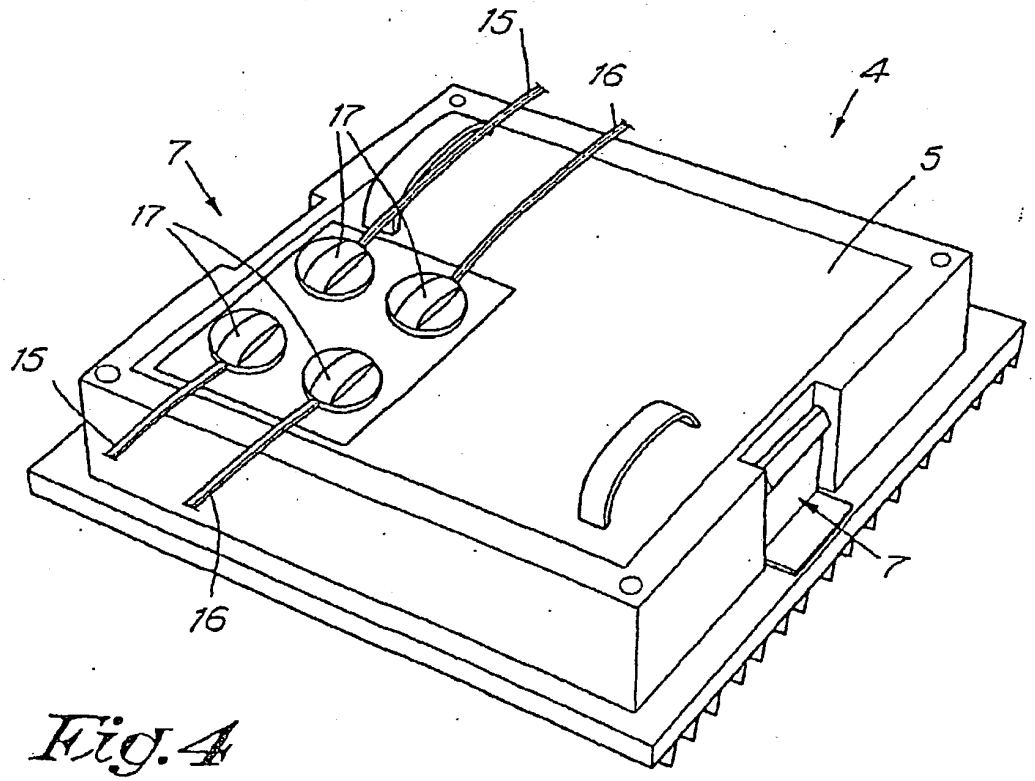

Fig.4

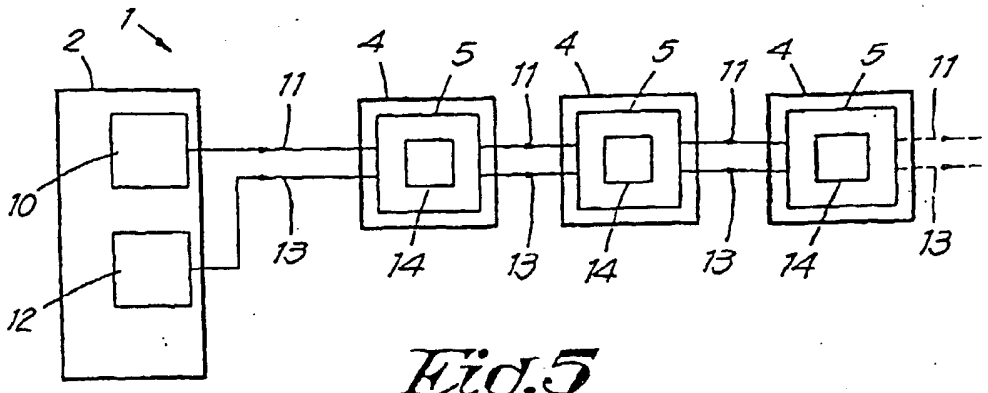

Fig.5

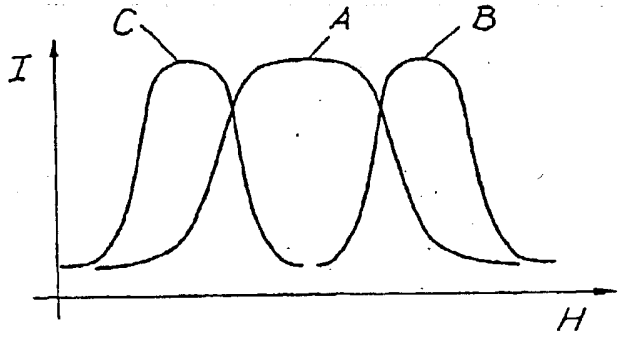

Fig.6

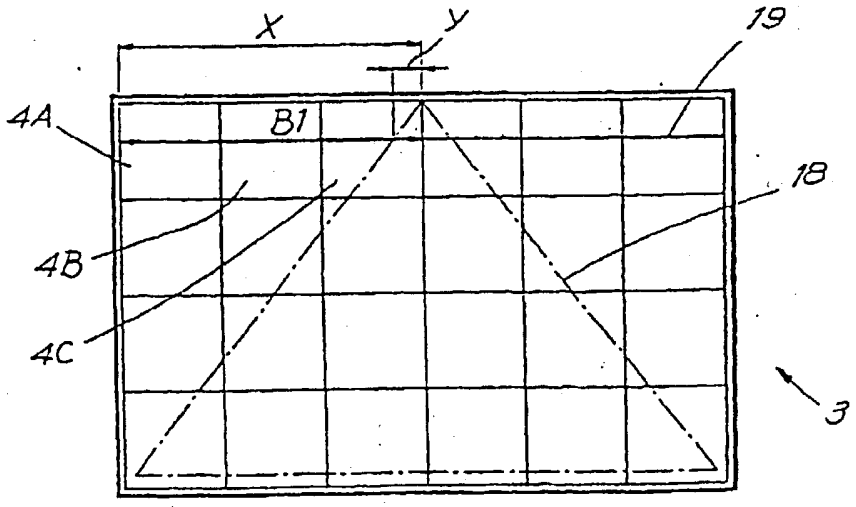

Fig.7

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　平3-78390

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		550		7709-2H
G 09 G	3/36			8621-5C
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			B	7605-5C

⑬公開　平成3年(1991)4月3日

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⑭発明の名称　液晶表示装置

⑳特　願　平1-216212

㉒出　願　平1(1989)8月21日

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明　細　書

1．発明の名称

液晶表示装置

2．特許請求の範囲

(1)　ある配列順序に従って、マトリクス状に配置した多数の画素より構成された一画面相当である被表示からなる液晶パネルと、

上記被表示列にて、フィールド周期で、該当に印加する電圧の極性を反転するように制御する交流化手段とを有する液晶表示装置において、

フルカラーを表現できる最小絵素を構成する赤、緑、青の各画素を赤、緑、緑、青の4つの絵素を田角形状に配置して1絵素を構成し、

上記交流化手段は、上記各画素をフィールド周期で極性反転する際、同じフィールド内で、赤、緑の各画素領域と青、緑の各画素領域とで、あるいは緑、緑の各画素領域と赤、青の各画素領域とで、それらに印加する電圧の極性が互いに逆の関係となるように制御するものであることを特徴とする液晶表示装置。

3．発明の詳細な説明

〔産業上の利用分野〕

この発明はＴＦＴ (Thin Film Transistor) アクティブマトリクス液晶ディスプレイ等の液晶表示装置に関し、特にそのフリッカ低減方法に関するものである。

〔従来の技術〕

第11図は従来例の液晶表示装置の等価回路図である。図において、1はマトリクス状に配された液晶セル、2は各液晶セル1と並列になされている充電用コンデンサ、3は各液晶セル1毎にその一方の電極（アレイ電極あるいは画素電極）に接続されて設けられている電界効果トランジスタ（ＦＥＴあるいはＴＦＴ）であって、これら3つの素子にて一画素を構成している。4はマトリクスの各列毎にＦＥＴ3の入力電極（ソース電極）に共通に接続された複数のＸ電極、5はマトリクスの各行毎にＦＥＴ3のゲート電極に共通接続された複数のＹ電極である。もたはＹ電極5に順次走査パルスを印加する走査回路、7は制御信号

をサンプリングしホールドすることにより一水平走査部分の映像信号をX電極群の並列の映像信号に変換し、X電極4に印加する直／並列映像回路であり、9は直／並列変換回路7に交流化映像信号を供給するため、輝度信号を交流化するR，G，Bの交流化回路である。8は全ての液晶セル1の他方の電極に共通接続された共通電極である。

第13図は第11図の各液晶セル上に記された従来のR，G，Bの画素形状及び画素配列を示すものである。この図で、点線枠がほぼ同じ時間でサンプリング表示される単位（1絵素）を示しており、この1つの絵素単位（1絵素）が従来例ではR，G，Bの3画素よりなっている。

次にこの表示装置を駆動する方法について説明する。

今、Y電極の1行目の電極をY1とすると、Y電極8の各電極、例えばY1～Yiの電極には第12図のY1～Yiのようなタイミングの映像信号が走査回路5により印加されている。この走査パルスがFET3のゲートに加わると、その選択された行の他のFET3はオン状態となり、X電極4から並列映像信号に応じた電荷がFET3を介して液晶用コンデンサ2に充電される。そして、FET3がオフ状態になっても、記憶用コンデンサ3に蓄えられた電荷により液晶に映像信号に対応した電圧が印加され続けるため、各液晶セルの透過光が映像信号により制御され表示できることになる。また、第13図に示したような絵素単位、例えばR，G，Bを同時刻でサンプリングし表示するというような方法は、直／並列変換回路7へのサンプリングクロックの与え方等によりコントロールできる。

なお、液晶に印加する電圧を印加し続けると寿命が短くなるという問題があるため、液晶に印加する電圧の極性が逆になっても、ほぼ同じ透過光特性を有していることを利用して共通電極8の電位に対して画素電極の電位がNTSC信号のフィールド周期（パネルでの表示輝度上ではフレーム周期）で反転するような信号処理を交流化回路9で行っており、この交流化された信号を映像信号として直／並列変換回路に供給している。

次に、画素配列については、現在、第13図のような水平方向にx，，垂直方向にy，なるサイズの1つの絵素単位が、垂直方向240個程度、水平方向320個程度で構成されている状況にある。ここで、垂直方向が240本程度となっている理由は、例えば垂直方向を480本程度にし、NTSC信号を同期にインタレース表示すると、1つの画素が書き換えられる周期がNTSC信号の1フレーム（1／30sec）となり、この周期で交流化を行なうと液晶の寿命の問題や、フリッカが大きくなる等の問題があるためである。

従って垂直方向は240本程度で、第1フィールドと第2フィールドを重ね書きし、パネル表示上は240本のノンインタレース表示をし、各画素の書き換え周期を1フィールド（1／60sec）とすることにより、これらの問題を避けている。

次に、従来のフリッカ対策に関しては、上述したように、液晶の寿命の関係でフィールド周期で交流化を行っているが、現実には液晶に加わる極性が異なると、正確に同じ透過率を示す訳ではない。この結果、フィールド周期（60Hz）で正極性の画面と負極性の画面が交互に現れることとなり、フレーム周期（30Hz）の明暗のフリッカが生じることになる。従来、この種の大画面フリッカの対策として、例えば第14図に示すように正極性あるいは負極性でドライブする画素を画中の斜線部と無斜線部に分割して大画面フリッカを低減していた。すなわち、何の対策も行わない場合、60Hzで画面全体が明／暗と変化するが、上記のような対策を行なうと画面の部分領域では同じく60Hzで、それぞれ明／暗を繰り返しているが、明／暗の領域が画面内に分散されているため、視覚的なLP（ローパス）効果が働き、明／暗の平均輝度として認知される訳である。しかしながら、従来のような画素配列で上記のような対策を行なうと、例えば第14図の場合は明／暗の縞のピッチが2x，となり、このピッチを小さくするにしても限界があるため、少し近づいてみ

るとLP効果がなくなり、明／暗の繰返しが時間と共に変化する、いわゆるラインフリッカの現象が現れるという問題があった。また、正極性ドライブと負極性ドライブの各領域を第15図のように分割するにしても一見明／暗のピッチが$2/3x_1$となり、小さくなるように思えるが、R，G，Bの各色との組み合わせで、やはり$2x_1$のピッチで大きな繰返しが現れ、これがラインフリッカとして現れるという問題があった。

〔発明が解決しようとする課題〕

従来の液晶表示装置は以上のように構成されていたので、大画面フリッカは低減できるものの、ラインフリッカが増大するという問題があった。

この発明は上記のような問題点を解消するためになされたもので、大画面フリッカ及びラインフリッカを低減できる液晶表示装置を得ることを目的とする。

〔問題を解決するための手段〕

この発明に係る液晶表示装置は、液晶パネルの1絵素の横長をR，G，G，Bの各画素を縦方向に配して構成し、同一走査内での正極性ドライブと負極性ドライブの各絵素の分割を、G・RとG・Bに、あるいはG・GとR・Bに分割するように駆動するようにしたものである。

〔作用〕

この発明においては、1絵素をR，G，G，Bの4画素を縦方向に配して構成し、G・RとG・BあるいはG・GとR・Bの各画素領域に分割し分散させて、その画素領域の極性を個別することにより、垂直方向の空間的余裕を有効に利用して明／暗の繰返しピッチを小さくすることができ、又、明／暗の輝度振幅を色相の変化に変換でき、視覚の空間，時間的な特性を考慮すると、そのフリッカに対する知覚を大幅に低減できる。

〔実施例〕

以下、この発明の一実施例を図について説明する。

第1図，第4図及び第5図は、1絵素をR，G，G，Bの4画素を四角状に配する構成とした本発明の一実施例による画素配列を示す図である。第1図において、実線枠は1絵素を構成しており、寸法的には従来例の第13図の水平，垂直の各1絵素の寸法x_1，y_1がそれぞれ第1図の実線枠の水平，垂直の寸法に対応している。

上記の画素配列で、G・RとG・BあるいはG・GとR・Bの各領域に分割して、交流化する際の極性を互いに逆極性となるようにとする訳であるが、この方法には、例えば第1図の画素配列パターンの場合には第2図及び第3図の、第4図の画素配列パターンの場合には第6図の、第5図の画素配列パターンの場合には第7図及び第8図のような分割方法が考えられる。図中の斜線領域と無斜線領域で、交流化の際の極性を互いに相対するようにし、各画素においても、時間的にフィールド周期で極性を反転することを示している。いずれの図も斜線領域と無斜線領域の分割はG・RとG・BあるいはG・GとR・Bの各画素に分割されている。また、回路的には第11図の従来例と同様であるが、図のR，G，B交流化回路9での正極性及び負極性の制御の仕方が、上述の各パターンに従うように変えられることになる。

次に本発明によるフリッカの低減効果について説明する。

まず、1絵素として、R，G，G，Bの4画素を四角状に配することにより、従来の構成の項でも述べたように垂直方向の空間的な余裕を有効に利用することになり、特に垂直方向の1画素のサイズは$y_1/2$となり、従来の半分となる。なお、このように1絵素を垂直方向にも2分割するため、駆動の面では2行分（1画素ライン分）同時に駆動することとなる。また、水平方向の画素サイズに関しては、ここでは一絵素の寸法を従来と同様にする（水平解像度を同等にする）という意味で、1絵素巾をx_1としているため1画素の水平巾は$x_1/2$となり、従来の$x_1/3$より若干大きくなる。しかし、実際にパネルを製作する段階では、3原色従来と同じ水平巾の画素サイズでも製作できる訳であるから、この場合パネルサイズを固定して考えると、従来より1．5倍の水平解像度を実現できることになる。

次にフリッカの見え方については、従来例では、近づくと第14図の例では、青／緑の縞模様が2x，のピッチで見え、この縞模様が時間と共に変化し、ラインフリッカとして知覚された。しかし、本発明では第2，3，5，7及び8図に示すように、いずれも縞模様のピッチがx，もしくはx，で現れる。実際のパネルは水平及び垂直解像度のバランスという面でx，≒x，となっているため、この縞模様のピッチは従来の約半分になっている。

第9図はTVハンドブックより抜粋した人間の空間ー相対感度に関する視覚特性である。図において、横軸がcycle/degree（cycle/degree）、縦軸が相対感度である。図のように明暗に比べ、赤ー緑や青ー黄のような色度的な解像は空間的に約10倍の巾が必要なことから、上記のように従来のピッチの約半分となっていることもあり、視感時には充分小さい値であると言える。

本発明では、交流化の為の画素分列をG・R（ー黄）とG・B（ーシアン）もしくはG・C（ー緑）とR・B（ーマゼンタ）に分割していることから、例えば第7図の場合、斜線部の輝度が等いとすると、R，G，B相互間の混色関では上述のように充分であるから、GとB及びGとRは混色してシアン系と黄系の縞模様がピッチx，で現れることになる。この場合、第9図にも示したように色相の変化は輝度変化に比べ、検知感が充分低いため従来と同じピッチの時でも、統合して空間的に知覚されにくいことになる。

なお、第15図の従来例の場合には、例えば図の斜線部の輝度が高いとすると、上述の理屈にそってマゼンタ系と緑系の色縞がピッチ2x，で並ぶことになる。しかし、マゼンタ系と緑系の縞はシアン系と黄系の縞に比べて、第9図に示したように視感度が高いこと、及び水平方向のピッチは絵画の画素単位での水平巾を等しいとすれば、更に小さくできること等から、やはり本発明の方がLP効果が大きくとれることになる。

最後に、時間的な輝度変動に関しては、人間の時間的な輝度変動に対する知覚に関しては約50～60Hzがフリッカ全般となり下限である。しかし、現在TVでは約30Hzの輝度変動となるためこの輝度変動が知覚されることになる。しかるに、本発明では変動周波数は従来と同じ30Hzであるが、その変動成分がシアン系とマゼンタ系の間が交互に変化するという色相的な変動となり、視覚特性的には、輝度よりも色相の時間変化の方が知覚されにくいものであるが（例えばテレビジョン全国大会p11，1973（坂田・相原）の文献によれば、非常感度周波数が3Hz（輝度の場合は10～20Hz）という報告がある。）、結局的に、フリッカが軽減されていることになる。

なお、上記実施例における第1，4，6図のような画素配列の1絵素を構成する基本配列は第10図に示したような配列としてもよく、上記実施例と同様の効果を得ることは言うまでもない。

（発明の効果）

以上のようにこの発明によれば、フルカラーを表現できる最小絵素を構成する赤，緑，青の各画素を赤，緑，黄，青の4つの領域を四角形状に配置して1絵素を構成し、その各画素をフィールド周期で画性反転する際、同じフィールド内で、赤と緑の各画素領域と、青と黄の各画素領域で、あるいは赤と黄の各画素領域と、赤と青の各画素領域で、それらに印加する電圧の極性が正負逆の関係となるように駆動するようにしたことにより、フリッカの現れ方がシアン系と黄系のような補色の異なる色領域が交互に変化し、更にその空間的なピッチも小さいものとなり、視覚の空間LP効果も強く働くのみでなく、時間的LP効果も強く働くことになり、ラインフリッカや大画面フリッカを大きく低減できる効果がある。

4．図面の簡単な説明

第1図，第4図，第6図は本発明の液晶表示装置の画素配列を示す図、第2図，第3図，第5図，第7図，第8図は本発明による正極性と負極性ドライブする際の画素分割の例を示す図、第9図の空間ー相対感度に対する人間の視覚特性を示す図、第10図は第1，4，6図の各画素配列の一絵素（1組織単位）の電子構成の他の例を示す図、第11図は液晶表示装置の等価回路図、第12図は

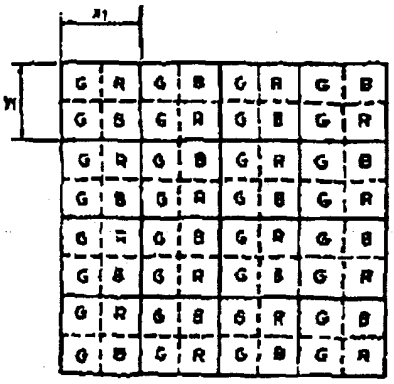
第１１図の走査回路の動作を説明する図、第１３図は従来の画素配列を示す図、第１４図、第１５図は従来のフリッカ対策を説明する図である。

図において、１は液晶セル、２は蓄積用コンデンサ、３はＦＥＴ、４はＸ電極、５はＹ電極、６は走査回路、７は垂直列表示回路、８は共通電極、９はＲ，Ｇ，Ｂ受光化膜等。

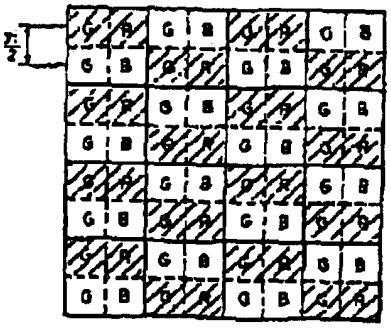
なお図中同一符号は同一又は相当部分を示す。

代理人　早　瀬　憲　一

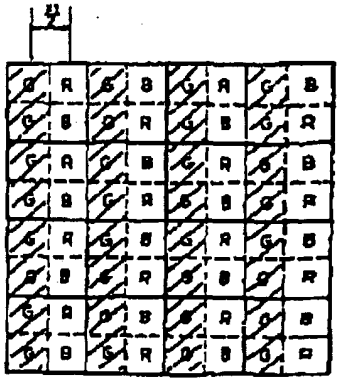
第１図



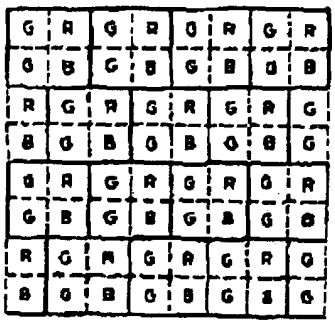
第２図



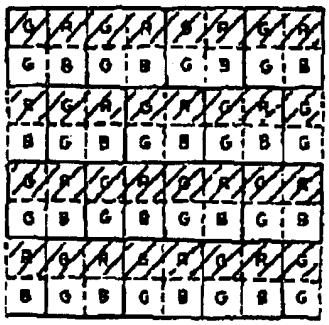
第３図



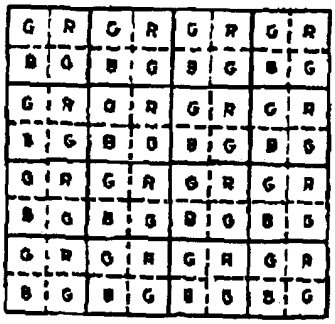
第4図



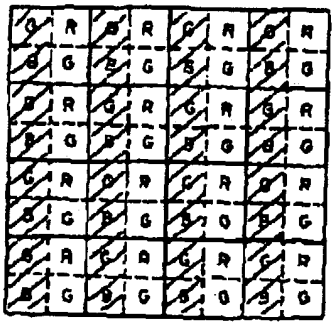
第5図



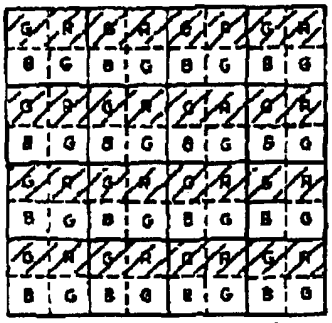
第6図



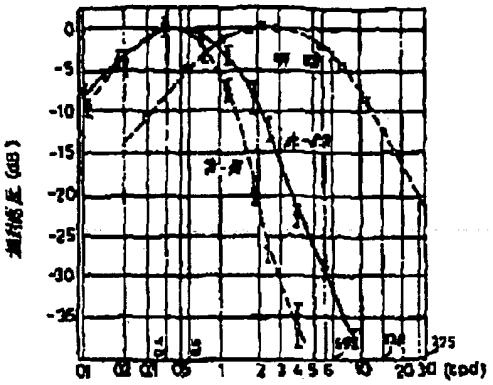
第7図



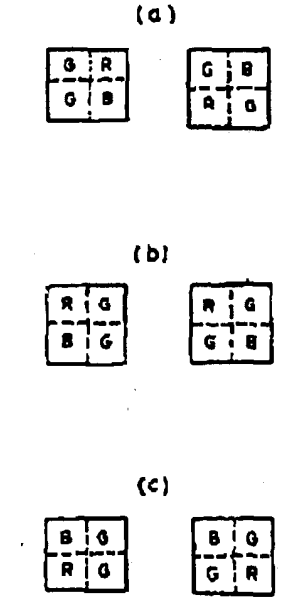
第 8 図



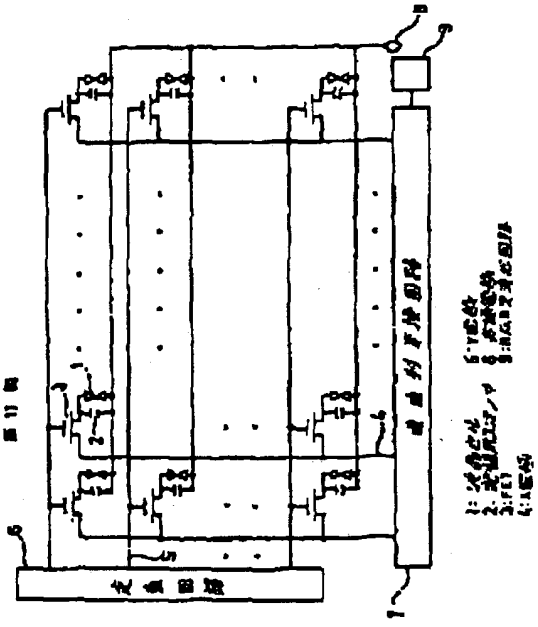
第 9 図



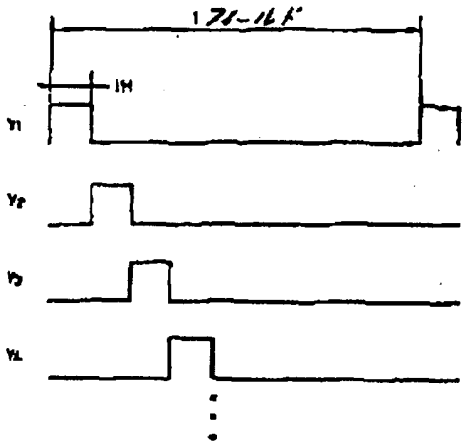
第 10 図



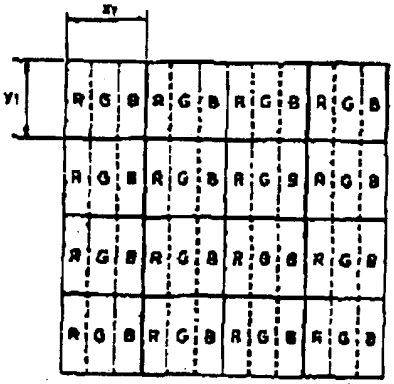
第 11 図



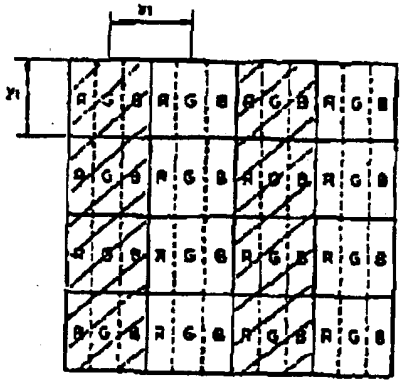
第 12 図



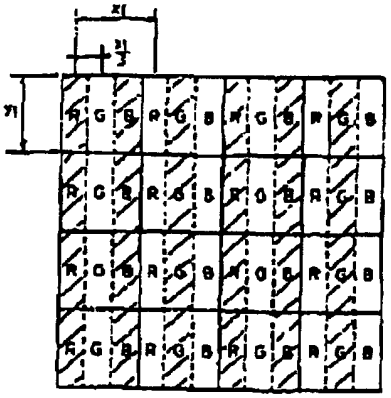
第 13 図



第 14 図



第 15 図



手続補正書（自発）

平成2年1月26日

特許庁長官 殿

1．事件の表示

特願平1－216212号

2．発明の名称

画像表示装置

3．補正をする者

事件との関係　特許出願人

住所　東京都千代田区丸の内二丁目2番3号

名称　(601) 三菱電機株式会社

代表者　志岐守哉

4．代理人　郵便番号 564

住所　大阪府吹田市江坂町1丁目23番43号

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方式審査

5．補正の対象

明細書の発明の詳細な説明の欄、及び図面の簡単な説明の欄

6．補正の内容

(1) 明細書第5頁第7行の「なにようにとする」を「なるようにする」に訂正する。

(2) 同第11頁第13行、及び第14頁第17行の「空間－相対座標」を「空間周波数－相対座標」に訂正する。

以上